Dalian Good Display Co., Ltd.

LCD Module User Manual
YM240128-01

Add.:No.17 Gonghua Street,Shahekou District, Dalian,116021, China

Tel.: 86-411-84619565

Fax: 86-411-84619585

E-mail: sales@good-lcd .com

Website: http://www.good-lcd.com

REVISION RECORD		
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Contents

1.Scope

This manual defines general provisions as well as inspection standards for standard LCD module. If the event of unforeseen problem or unspecified items may occur, please contact the nearest supplier or our company.

2.Warranty

If module is not stored or used as specified in this manual, it will be void the 12-month warranty.

3.Features

3-1. Features

(1) Display mode: Transmissive /Negative
STN LCD

(2) Display color: Display dots: White
Background: Blue

（3）Display Format: 240(w)×128(h) full dots

(4)Input data: 8-bit parallel data interfaced from a MPU

(5) Multiplex ratio: 1/128 Duty, 1/12.3 Bias

（6）Viewing direction: 6 O'clock

(7) Back light: LED White

(8) Controller: T6963C

3-2. Mechanical features

Item	Specifications	Unit
Outline dimensions	144.0(W)×104.0(H) ×16.0Max.(T)	mm
Viewing Area	114.0(W)×64.0(H)	mm
Image Area	107.95(W)×57.55(H)	mm
Number of Dots	240 (W)×128(H)	---
Dot Size	0.4(W)×0.4(H)	mm
Dot Pitch	0.45(W)×0.45(H)	mm
Weight	---	g

3-3. Absolute maximum ratings

Item	Symbol	Condition	Min	Max	Units
Power supply for logic	Vdd-Vss	25℃	-0.3	7.0	V
Operating voltage for LCD	Vdd-V0	25℃	0	30.0	V
Input voltage	Vin	25℃	-0.3	Vdd+0.3	V
Operating temperature	Top	---	–10	60	℃
Storage temperature	Tstg	---	–20	70	℃

Note:

1) The modules may be destroyed if they are used beyond absolute maximum ratings. In ordinary operation, it is desirable to use them within recommended operation conditions. Using the modules beyond these conditions may cause malfunction and poor reliability.

2) All voltage values are referenced to GND=0V.

3-4 Electrical Characteristics

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	Logic	Vdd	—	4.5	5.0	5.5	V
	LCD drive	Vdd–Vee	—	—	19.7	---	
Input Voltage	"H" Level	Vih	Vdd=5V±5%	Vdd-2.2	—	Vdd	
	"L" Level	Vil	—	0	—	0.8	
Output Voltage	"H" Level	Voh	---	Vdd-0.3	—	Vdd	
	"L" Level	Vol	---	0	—	0.3	
Operating Frequency		Fosc	---	0.4	---	5.5	MHz
Current Consumption		Idd(1)	Vdd=5V Fosc=3MHz(Note 4)	—	3.3	—	mA
		Idd(2)	Vdd=5V,without backlight	—	5.0	—	mA

Note: <1> Duty =1/240

<2> All the dots are on static state.

<3> LCD driving voltage is provided externally.

<4> MDS=L,MD0=L,MD1=L,MD2=H,MD3=H,FS0=L,FS1=L,/SDSEL=L,/DUAL=H, D7 to D0=LHLHLHLH

3-5 Electro-optical Characteristics

Item		Symbol	Temp.	Conditions	Min.	Typ.	Max.	Unit
LCD Driving Voltage(blue) (Recommended voltage)		Vop	25℃	$\phi=0°$, $\theta=0°$	---	19.7	----	
Response Time	Rise Time	tr	0℃	$\phi=0°$, $\theta=0°$	—	500	700	us
			25℃		—	200	250	
	Decay Time	td	0℃		—	540	810	
			25℃		—	250	300	
Viewing angle		$\triangle\phi$	25℃	Vertical	-35	—	35	deg.
				Horizontal	-30	---	30	
Contrast Ratio		K	25℃	$\phi=0°$, $\theta=0°$	2.0	5.0	—	—

3-6 LED back light specifications

Item	`Unit	Standard Values			Condition
		Min.	Typ.	Max.	
Supply Voltage	V	—	3.2	---	—
Brightness	cd/m^2	150	200	—	----
Current	mA	----	60	----	----
Lifetime	Hrs	10000			----
Luminous Color	—	White			----
Operating Temp.	℃	-20 ~ +70			—
Storage Temp.	℃	-30 ~ +80			—

4. Mechanical Diagram
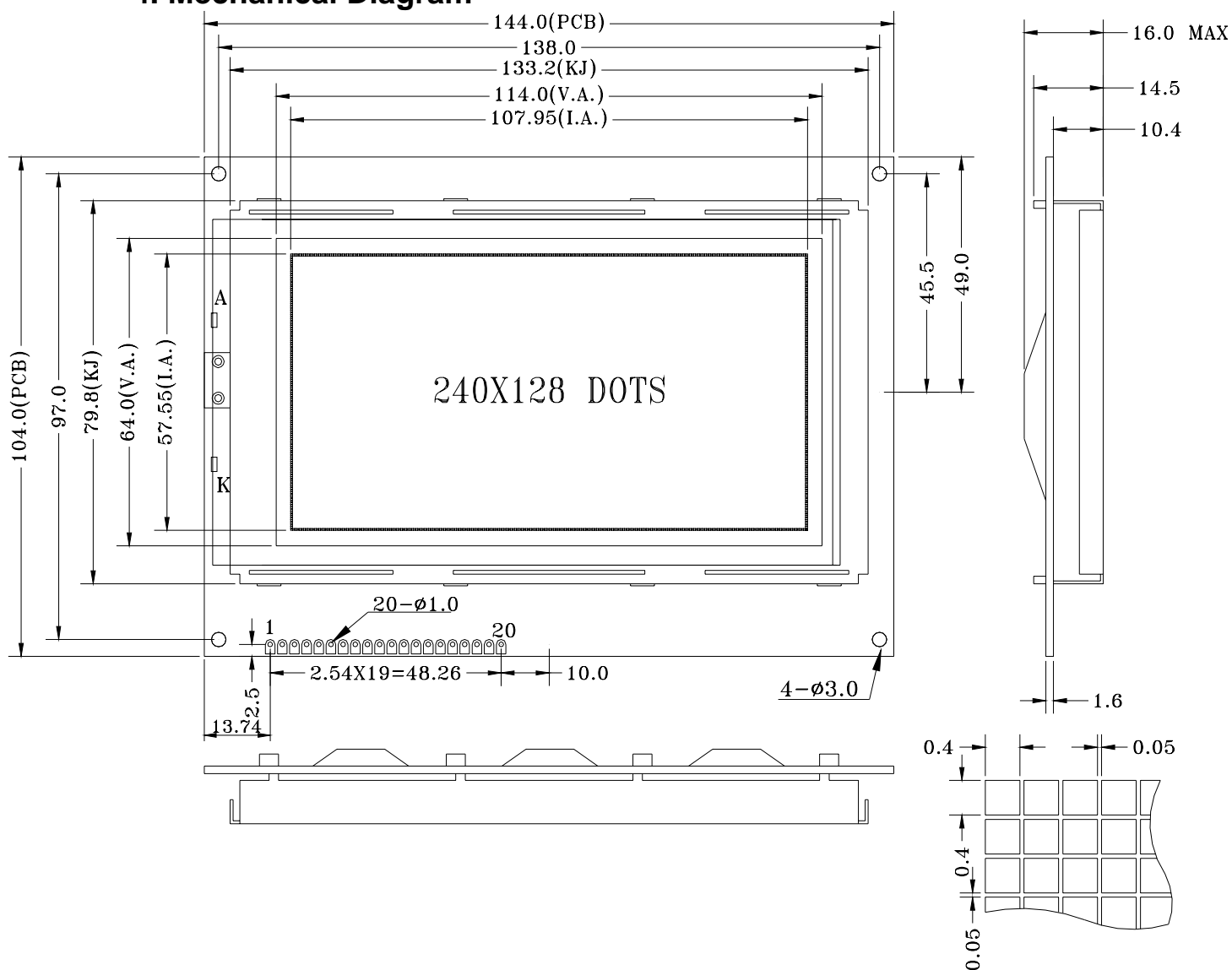
5.I/O Terminal

5-1 I/O Connection

Pin No.	Symbol	Function
1	BL+	Power supply for LED (+5.0V)
2	BL-	Power supply for LED (-)
3	FG	Frame ground
4	VSS	Power supply (GND)
5	VCC	Power supply (+5.0V)
6	VEE	Contrast adjust
7	/WR	When /wR="L", MPU executes WRITE operation to module.
8	/RD	When R/W="H", MPU executes READ operation to module.
9	CS	Chip selected terminal
10	RS	Register select signal RS=0, Instruction register (for write)RS=1, Data register
11	RST	Controller Reset signal
12-19	DB0-DB7	Data bus line.
20	FS	Font Selection; FS=1,6X8;FS=0;8X8

5-2 Signal timing diagram

Item	Symbol	Condition	Min.	Max.	Unit
C/D set-up time	tcds		100	—	
C/D hold time	tcdh		10	—	
CE,RD,WR pulse width	tcp,trp,twp	Vdd=5V±5%	80	—	
Data set-up time	tds	Vss=0V	80	—	ns
Data hold time	tdh	Ta=25℃	40	—	
Access time	tacc		—	150	
Output hold time	toh		10	50	

Bus timing
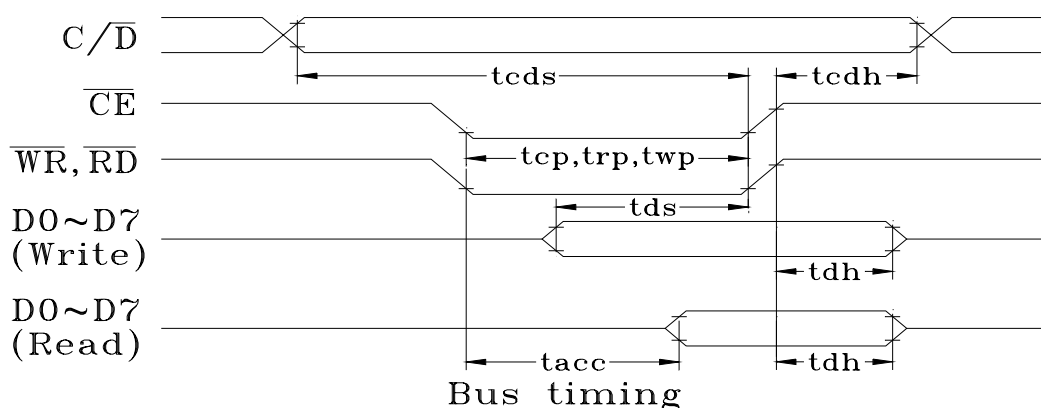
5-3 Display command

COMMAND	CODE	D1	D2	FUNCTION
REGISTERS SETTING	00100001	X address	Y address	Set Cursor Pointer
	00100010	Data	00H	Set Offset Register
	00100100	Low address	High address	Set Address Pointer
SET CONTROL WORD	01000000	Low address	High address	Set Text Home Address
	01000001	Columns	00H	Set Text Area
	01000010	Low address	High address	Set Graphic Home Address
	01000011	Columns	00H	Set Graphic Area
MODE SET	1000X000	—	—	OR mode
	1000X001	—	—	EXOR mode
	1000X011	—	—	AND mode
	1000X100	—	—	Text Attribute mode
	10000XXX	—	—	Internal CG ROM mode
	10001XXX	—	—	External CG RAM mode
DISPLAY MODE	10010000	—	—	Display off
	1001XX10	—	—	Cursor on, blink off
	1001XX11	—	—	Cursor on, blink on
	100101XX	—	—	Text on, graphic off
	100110XX	—	—	Text off, graphic on
	100111XX	—	—	Text on, graphic on
CURSOR PATTERN SELECT	10100000	—	—	1-line cursor
	10100001	—	—	2-line cursor
	10100010	—	—	3-line cursor
	10100011	—	—	4-line cursor
	10100100	—	—	5-line cursor
	10100101	—	—	6-line cursor
	10100110	—	—	7-line cursor
	10100111	—	—	8-line cursor
DATA AUTO READ/WRITE	10110000	—	—	Set Data Auto Write
	10110001	—	—	Set Data Auto Read
	10110010	—	—	Auto Reset
DATA READ/WRITE	11000000	Data	—	Data Write and Increment ADP
	11000001	—	—	Data Read and Increment ADP
	11000010	Data	—	Data Write and Decrement ADP
	11000011	—	—	Data Read and Decrement ADP
	11000100	Data	—	Data Write and Nonvariable ADP
	11000101	—	—	Data Read and Nonvariable ADP
SCREEN PEEK	11100000	—	—	Screen Peek
SCREEN COPY	11101000			Screen Copy
BIT SET/RESET	11110XXX	—	—	Bit Reset
	11111XXX	—	—	Bit Set
	1111X000	—	—	Bit 0 (LSB)
	1111X001	—	—	Bit 1
	1111X010	—	—	Bit 2
	1111X011	—	—	Bit 3
	1111X100	—	—	Bit 4
	1111X101	—	—	Bit 5
	1111X110	—	—	Bit 6
	1111X111	—	—	Bit 7 (MSB)

5-4．Application features of module:

（1） This module can be directly connected to 8080MPU or Z80MPU.

（2） This module can be set to display in combined display of graphic and text (Contents of the text area and of the graphic area are displayed on the screen simultaneously by mode set.) and in attribute display of text mode.

（3） MPU can access the DDRAM at any time in the mode of byte / bit operation.

（4） Character Font: 6×8 dots or 8×8 dots

（5） A status check must be performed before data or command are read or written.

（6） Both the column/line counter and display register are cleared by RESET. (Other registers are not cleared.) DDRAM is kept intact. Disable the display using the clear-display register. After power on, it is necessary to reset by software.

（7） By the hardware setting, display columns are defined 40 characters long, maximum transferable amount of data every line.

（8） Display lines are defined 128 by hardware setting.

（9） This module has a 128-word character generator ROM (see appendix), and allocation of external character generator RAM can be made easily in DDRAM.

（10） DDRAM can be allocated to text area, graphic area and external character area. The text home address and the graphic home address correspond to the display bit on the top left corner of the LCD panel. In 6×8 dot matrix, one byte in the text area corresponds to a character on the screen. One byte in graphic area corresponds to 6×1 dot matrix on the screen (The lower 6 bits of a byte are valid).

（11） Cursor display mode is on only in the text mode and what is displayed is the logic OR of cursor and the character where the cursor is.

（12） For some commands that need operand data, it is important to send the operand data first and then the command code.

（13）Text Attribute mode is only applicable in text mode. (In this case, text mode and graphic mode should both be on.)

（14）The relationship between Text Area and display position in LCD panel is shown below:

TH	TH+1	…	TH+CL
TH+TA	TH+TA+1	…	TH+TA+CL
(TH+TA）+TA	(TH+TA）+TA+1	…	TH+2TA+CL
(TH+2TA）+TA	(TH+2TA）+TA+1	…	TH+3TA+CL
…	…	…	…
TH+15TA	TH+15TA+1	…	TH+15TA+CL

Note: TH: the text home address

TA: the width of text area (number of characters /line), to be defined by user.

CL: number of characters/line set by hardware, the CL of this module is 40.

（15）The relationship between Graphic Area and display position in LCD panel is shown below:

GH（DB7~DB0）	GH+1	…	GH+CL
GH+TA	GH+TA+1	…	GH+TA+CL
(GH+TA）+TA	(GH+TA）+TA+1	…	GH+2TA+CL
(GH+2TA）+TA	(GH+2TA）+TA+1	…	GH+3TA+CL
…	…	…	…
GH+127TA	GH+127TA+1	…	GH+127TA+CL

Note:

GH: the graphic home address

TA: the width of graphic area (number of characters /line), to be defined by user.

CL: number of characters/line set by hardware, the CL of this module is 40.

NOTE: the detail of the software settings, please refer T6963 datasheet.

6. Quality Level

6-1.   Inspection conditions

6-1-1.   The environmental conditions for inspection shall be as follows:

           Room temperature: 20±3℃

               Humidity: 65±20% RH

6-1-2.   The external visual inspection:

The inspection shall be performed by using a 20W fluorescent lamp for illumination.
The distance between LCD and the inspector's eyes should be at least 30cm.

6-1-3.   (1) Light method

Y

Display Surface

X

Fluorescent lamp set the perpendicular
to the display surface
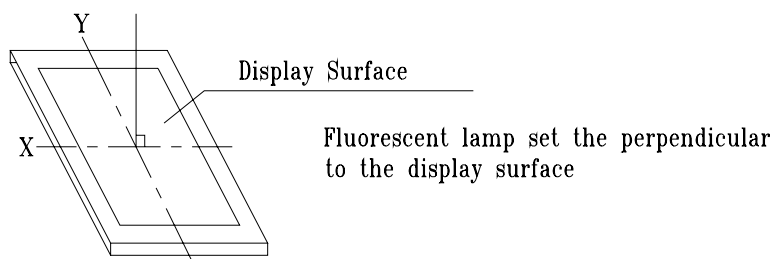
(2) Inspection distance and angle

Z

Y 30°

30°

X

Inspection should be performed within ∅
(∅=30°) from Z axis to each X and Y axis.

Inspection distance of any direction within ∅
must be kept 30±50cm to the display surface.
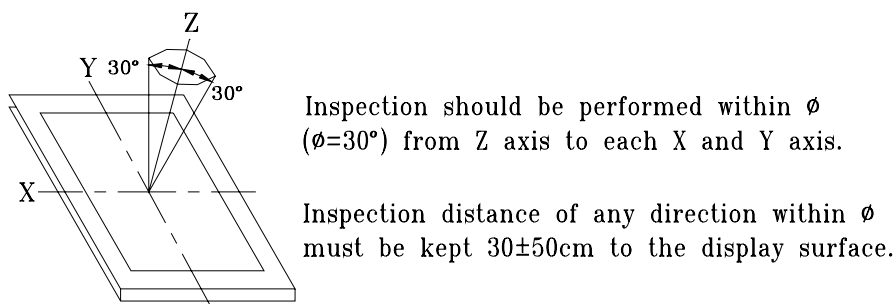
6-2. Sampling procedures for each item's acceptance level table

Defect type	Sampling procedure	AQL
Major defect	MIL-STD-105D Inspection Level I Normal inspection Single sample inspection	Q/GD-07-2006(1)
Minor defect	MIL-STD-105D Inspection Level I Normal inspection Single sample inspection	Q/GD-07-2006(1)

6-3. Classification of defects

6-3-1. Major defect

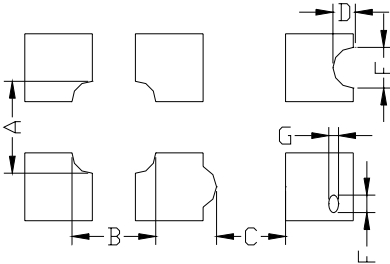A major defect refers to a defect that may substantially degrade usability for product applications

6-3-2. Minor defect

A minor defect refers to a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.

6-4 .Inspection standards

Item	Criterion for defects	Defect type
1) Display on inspection	(1)　Non display　　　　　　(2) Vertical line is deficient (3)　Horizontal line is deficient　(4) Cross line is deficient	Major
2) Black／White spot	<table><tr><td>Size　Φ(mm)</td><td>Acceptable number</td></tr><tr><td>Φ≤0.3</td><td>Ignore (note)</td></tr><tr><td>0.3<Φ≤0.45</td><td>3</td></tr><tr><td>0.45<Φ≤0.6</td><td>1</td></tr><tr><td>0.3<Φ</td><td>0</td></tr></table> (Note) Not allowed if four more spots crowd together	Minor
3) Black／White line	<table><tr><td>Length (mm)</td><td>Width (mm)</td><td>Acceptable number</td></tr><tr><td>L≤10</td><td>W≤0.03</td><td>Ignore</td></tr><tr><td>5.0≤L≤10</td><td>0.03<W≤0.04</td><td>3</td></tr><tr><td>5.0≤L≤10</td><td>0.04<W≤0.05</td><td>2</td></tr><tr><td>1.0≤L≤10</td><td>0.05<W≤0.06</td><td>2</td></tr><tr><td>1.0≤L≤10</td><td>0.06<W≤0.08</td><td>1</td></tr><tr><td>L≤10</td><td>0.08<W</td><td>follows 2) point defect</td></tr></table> Defects separate with each other at an interval of more than 20mm.	Minor
4) Display pattern	 [Unit: mm] $\dfrac{A+B}{2}\leq0.45$　$0<C$　$\dfrac{D+E}{2}\leq0.35$　$\dfrac{F+G}{2}\leq0.35$ Note: 1) Up to 3 damages acceptable 　　　2) Not allowed if there are two or more pinholes every three-fourths inch.	Minor
5) Spot-like contrast irregularity	<table><tr><td>Size　Φ(mm)</td><td>Acceptable Number</td></tr><tr><td>Φ≤0.7</td><td>Ignore (note)</td></tr><tr><td>0.7<Φ≤1.0</td><td>3</td></tr><tr><td>1.0<Φ≤1.5</td><td>1</td></tr><tr><td>1.5<Φ</td><td>0</td></tr></table> Note: 1) Conformed to limit samples. 　　　2) Intervals of defects are more than 30mm.	Minor

Item	Criterion for defects			Defect type
6) Bubbles in polarizer	Size Φ(mm)	Acceptable Number		Minor
	$\Phi \leqslant 0.4$	Ignore (note)		
	$0.4 < \Phi \leqslant 0.65$	2		
	$0.65 < \Phi \leqslant 1.2$	1		
	$1.2 < \Phi$	0		
7) Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with "2) Black/white spot", and "3) Black/White line".			Minor
8) Stains on the surface of LCD panel	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning.			Minor
9) Rainbow color	No rainbow color is allowed in the optimum contrast on state within the active area.			Minor
10) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.			Minor
11) Bezel appearance	Rust and deep damages that are visible in the bezel are rejected.			Minor
12) Defect of land surface contact	Evident crevices that are visible are rejected.			Minor
13) Parts mounting	(1) Failure to mount parts (2) Parts not in the specifications are mounted (3) For example: Polarity is reversed, HSC or TCP falls off.			Major
14) Part alignment	(1) LSI, IC lead width is more than 50% beyond pad outline. (2) More than 50% of LSI, IC leads is off the pad outline.			Minor

15) Conductive foreign matter (solder ball, solder hips)	(1) $0.45 < \Phi$, $N \geqslant 1$
	(2) $0.3 < \Phi \leqslant 0.45$, $N \geqslant 1$
	     Φ: Average diameter of solder ball (unit: mm)
	(3) $0.5 < L$, $N \geqslant 1$
	     L: Average length of solder chip (unit: mm)
				Major
				
				Minor
				
				Minor

16) PCB pattern damage	(1) Deep damage is found on copper foil and the pattern is nearly broken. (2) Damage on copper foil other than 1) above			Major Minor
17) Faulty PCB correction	(1) Due to PCB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair;2 or more places are corrected per PCB. (2) Short-circuited part is cut, and no resist coating has been performed.			Minor
18) Bezel flaw	Bezel claw missing or not bent			Minor
19) Indication on name plate (sampling indication label)	(1) Failure to stamp or label error, or not legible. (all acceptable if legible) (2) The separation is more than 1/3 for indication discoloration, in which the characters can be checked.			Minor

7.Reliability

7-1 Lifetime

50,000 hours (25℃ in the room without ray of sun)

7-2 Items of reliability

Item	Condition	Criterion
1) High Temperature Operating	60℃ 96hrs	No cosmetic failure is allowable. Contrast ratio should be between initial value ±10%. Total current consumption should be below double of initial value.
2) Low Temperature Operation	-20℃ 96hrs	
3) Humidity	40℃, 90%RH, 96hrs	No cosmetic failure is allowable. Contrast ratio should be between initial value ±20%. Total current consumption should be below double of initial value.
4) High Temperature	70℃ 96hrs	
5) Low Temperature	-30℃ 96hrs	
6) Thermal shock	25℃→30℃→25℃→70℃ 5(min) 30(min) 5(min) 30(min) 5 cycle, 55~60%RH	
7) Vibration	10~55~10hz amplitude: 1.5mm 2hrs for each direction (X,Y,Z)	No defects in cosmetic and operational function are allowable. Total current consumption should be below double of initial value.

8. Handling precautions

8-1 Mounting method

A panel of LCD module, made by Dalian Good Display Co., Ltd., consists of two thin glass plates with polarizes that easily get damaged.
And since the module is constructed and fixed by utilizing fitting holes in the printed circuit board (PCB), extreme care should be used when handling the LCD modules.

8-2 Cautions of LCD handling and cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.
   □   Isopropyl alcohol
   □   Ethyl alcohol
   □   Trichlorotriflorothane
Do not wipe the display surface with dry or hard materials that may damage the polarizer surface.
Do not use the following solvents:
   □   Water
   □   Ketene
   □   Aromatics

8-3 Caution against static charge

The LCD module uses C-MOS LSI drivers. So we recommend you:

Connect any unused input terminal to V_{dd} or V_{ss}. Do not input any signals before power turns on, and ground your body, work/assembly areas, and assembly equipment to protect against static electricity.

8-4 Packaging
- A module employs LCD elements, and must be treated as such.
  Avoid intense shock and falling from a height.
- To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

8-5 Caution for operation
- It is an indispensable condition to drive LCD module within the limits of the specified voltage since the higher voltage over the limits may cause the shorter life of LCD module.
  An electrochemical reaction due to DC (direct current) causes LCD undesirable deterioration so that the use of DC (direct current) drive should be avoided.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD module may show dark color in them. However those phenomena do not mean malfunction or out of order of LCD module, which will come back in the specified operating temperature.

8-6 Storage
In the case of long time storage, the following ways are recommended:
- To be stored in polyethylene bag with the opening sealed so not to prevent the fresh air in. And with no desiccant.
- To be placed in a dark place where there is neither exposure to direct sunlight nor light is. Keep the storage temperature range.
- To be stored with no touch on surface of polarizer by any thing else.

8-7 Safety
- It is recommended to crash damaged or unnecessary LCD into pieces and to wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off at once with soap and water.

9. Precaution for use
9-1 Both parties should provide a limit sample on an occasion when both parties agree to its necessity.
  The judgment by a limit sample shall take effect after the limit sample has been established and confirmed by both parties.
9-2 On the following occasions, handling problem should be decided through discussion and agreement between responsible of the both parties.
- When a question is arisen in this manual.
- When a new problem is arisen that is not specified in this manual.
- Some problem is arisen due to the change of inspection and operating conditions in users.
- When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.